What is claimed:

1. A vibratory apparatus for moving a driven element, comprising:

a vibration source that converts electrical energy directly into physical motion, and a resonator having an opening defined by at least two opposing sidewalls which are stressed beyond their elastic limit to hold the vibration element in compression, the vibration source being within that opening so that the vibration element is held in compression by the resonator under a defined preload, the vibration source causing the resonator to vibrate in at least a first mode to cause a selected contacting portion on the resonator to move in a predetermined manner.

2. The apparatus of Claim 1, wherein the vibration source is press-fit into the opening.

3. The apparatus of Claim 2, wherein the vibratory element is a piezoelectric element.

4. The apparatus of Claim 2, wherein the at least two sidewalls are curved.

5. The apparatus of Claim 3, wherein the at least two sidewalls are curved.

6. The apparatus of Claim 3, wherein the piezoelectric element has at least two opposing edges that are inclined and located to engage edges of the opening to make it easier to press-fit the piezoelectric element into the opening while reducing damage to the piezoelectric element.

7. The apparatus of Claim 5, wherein the piezoelectric element has at least two opposing edges that are inclined and located to engage edges of the opening to make it easier to press-fit the piezoelectric element into the opening while reducing damage to the piezoelectric element.

8. The apparatus of Claim 3, wherein the piezoelectric element has at least two opposing edges that have surfaces substantially parallel to the abutting walls defining the opening, and an inclined surface extending therefrom to a contacting surface abutting one of the walls, the contacting surface exerting the preload on the piezoelectric element to place the piezoelectric element in compression.

9. The apparatus of Claim 3, wherein the opening in the resonator is defined by at least two opposing edges that are inclined and located to make it easier to press-fit the piezoelectric element into the opening.

10. The apparatus of Claim 5, wherein the opening in the resonator is defined by at least two opposing edges that are inclined and located to make it easier to press-fit the piezoelectric element into the opening.

11. The apparatus of Claim 3, further comprising a resilient support element for supporting the apparatus, the support element being interposed between the piezoelectric element and a portion of the resonator opening.

12. The apparatus of Claim 5, further comprising a resilient support element for supporting the apparatus, the support element being interposed between the piezoelectric element and a portion of the resonator opening.

13. The apparatus of Claim 3, wherein the first mode is excited by a first electrical signal applied to the piezoelectric element that results in the selected contacting portion moving in an elliptical motion of sufficient amplitude to move a driven element in a first direction when the apparatus is engaged with the driven element during use of the apparatus.

14. The apparatus of Claim 13, wherein the resonator is excited by a second electrical signal applied to the piezoelectric element that results in the selected contacting portion moving in a second elliptical motion of sufficient amplitude to move a driven element in a second direction when the apparatus is engaged with the driven element during use of the apparatus.

15. The apparatus of Claim 5, wherein the resonator is excited by a second electrical signal applied to the piezoelectric element that results in the selected contacting portion moving in a second elliptical motion of sufficient amplitude to move a driven element in a second direction when the apparatus is engaged with the driven element during use of the apparatus.

16. The apparatus of Claim 3, wherein the selected contacting portion is resiliently placed in contact with a driven element that is constrained to move in a predetermined manner and caused to move by the first elliptical motion.

17. The apparatus of Claim 13, wherein the selected contacting portion is resiliently placed in contact with a surface on the driven element that is constrained to move in a predetermined manner and caused to move by the selected contacting portion engaging the surface.

18. The apparatus of Claim 2, further comprising a second resonator having a second opening defined by at least two opposing sidewalls which are stressed beyond their elastic limit, and a second vibration source that converts electrical energy directly into physical motion, the second vibration source being press-fit within that second opening so the second resonator holds the second vibration source in compression under a defined preload, the vibration source being placed in a position to cause the second resonator to vibrate in at least a first resonant mode to cause a selected contacting portion on the second resonator to move in a predetermined manner, the first and second resonators being arranged so the selected contacting portion of each resonator drivingly engages the same driven element.

19. A piezoelectric apparatus for moving a driven element, comprising:

a resonator having a longitudinal axis with an opening partially defined by two sidewalls on opposing sides of the longitudinal axis and two opposing end walls on the longitudinal axis, a piezoelectric element held in compression by the opposing end walls, each of the sidewalls being stressed beyond its elastic limit to hold the piezoelectric element in compression, the resonator having a selected contacting portion which moves in a first elliptical motion when the piezoelectric element is excited by a first electrical signal.

20. The piezoelectric apparatus of Claim 19, wherein the sidewalls are curved.

21. The piezoelectric apparatus of Claim 19, wherein at least one of the end walls or two opposing sides of the piezoelectric element that engage the end walls have edges that are inclined to facilitate press-fitting the piezoelectric element into the opening and wherein the piezoelectric element is press-fit between the end walls.

22. The piezoelectric apparatus of Claim 19, wherein at least one of the sidewalls is curved so it bows away from the piezoelectric element.

23. The piezoelectric apparatus of Claim 19, wherein at least one of the sidewalls is curved so it bows toward the piezoelectric element.

24. The piezoelectric element of claim 19, wherein a portion of an elastic element for supporting the resonator is interposed between one of the end walls and the piezoelectric element.

25. A method of placing a piezoelectric element in compression in a resonator, the resonator having end walls and sidewalls defining an opening sized to receive and place the piezoelectric element in compression, comprising:

increasing the distance between opposing end walls enough to allow the piezoelectric element to be forced between the end walls with a force that by itself could not force the piezoelectric element between the end walls in the original state of the opening, and thereby placing the piezoelectric element in compression while also stressing the sidewalls beyond their elastic limit.

26. The method of Claim 25, further comprising providing an inclined surface on at least one of either the end walls or the corresponding edges of the piezoelectric element, and forcing the piezoelectric element into the opening by engaging said at least one inclined surface.

27. The method of Claim 25, comprising pulling the opposing end walls apart while forcing the piezoelectric element into the opening.

28. The method of Claim 25, wherein the sidewalls are curved.

29. The method of Claim 26, wherein the sidewalls are curved.

30. The method of Claim 25 wherein the sidewalls are curved away from each other, and comprising urging the opposing, curved sidewalls toward each other in order to move the end walls away from each other and then placing the piezoelectric element between the end walls.

31. The method of Claim 25 wherein the sidewalls are curved toward each other, and comprising urging the opposing, curved sidewalls away from each other in order to move the end walls away from each other and then forcing the piezoelectric element between the end walls.

32. The method of Claim 25, comprising interposing a resilient mount for the piezoelectric element between the piezoelectric element and one of the end walls.

33. The method of Claim 26, comprising interposing a resilient mount for the piezoelectric element between the piezoelectric element and one of the end walls.

34. The method of Claim 25, wherein the resonator has a longitudinal axis passing through the opening with the sidewalls being on opposing sides of that axis and the end walls on the longitudinal axis.

35. A piezoelectric element configured to be press-fit into an opening in a resonator, the opening being defined by sidewalls located on opposing sides of a longitudinal axis through the opening and separated by a first dimension, and opposing end walls located on the longitudinal axis and separated by a second dimension, comprising:

a piezoelectric element having a first dimension that is smaller than the first dimension of the opening and having a second dimension larger than the second dimension of the opening and selected to stress the sidewalls beyond their elastic limit when the piezoelectric element is inserted into the opening, the piezoelectric element having inclined edges corresponding in location to edges of the end walls when the piezoelectric element is aligned to be inserted into the opening.

36. The piezoelectric element of Claim 35, wherein the sidewalls are curved toward or away from the piezoelectric element.

37. A piezoelectric element configured to be press-fit into an opening in a resonator, the opening being defined by sidewalls located on opposing sides of a longitudinal axis through the opening and separated by a first dimension, and opposing end walls located on the longitudinal axis with a resilient support for the resonator being interposed between one end wall and the piezoelectric element during use, the contacting end wall and the contacting surface of the resilient support being separated by a second dimension, comprising:

a piezoelectric element having a first dimension smaller than the first dimension of the opening and having a second dimension larger than the second dimension of the opening and selected to stress the sidewalls beyond their elastic limit when the piezoelectric element is inserted into the opening with the resilient support interposed between the piezoelectric element and one end wall, the piezoelectric element having at least one inclined edge corresponding in location to at least the edge of the end wall when the piezoelectric element is aligned to be inserted into the opening.

38. The piezoelectric element of Claim 37, wherein the sidewalls are curved toward or away from the piezoelectric element when that element is inserted into the opening.

39. A piezoelectric element configured to be press-fit into an opening in a resonator, the opening being defined by sidewalls located on opposing sides of a longitudinal axis through the opening and separated by a first dimension, and opposing end walls located on the longitudinal axis with a resilient support for the resonator being interposed between one end wall and the piezoelectric element during use, the end walls being separated by a second dimension, wherein the piezoelectric element has edges on surfaces that are located to engage walls defining the opening, with the edges having inclined surfaces on them to make it easier to press-fit the piezoelectric element into the opening.

40. A resonator for use with a piezoelectric actuator, the resonator having a continuous walled, externally accessible opening sized to receive a piezoelectric element and hold the element in compression, the opening being defined in part by opposing sidewalls that are curved.

41. The resonator of Claim 40, wherein the sidewalls are curved away from the opening.

42. The resonator of Claim 40, wherein the curved sidewalls have a uniform cross section for a substantial portion of the length of the sidewall.

43. The resonator of Claim 40, wherein the curved sidewalls have a rectangular cross section.

44. The resonator of Claim 40, wherein the opening comprises opposing end walls on a longitudinal axis of the opening, the sidewalls being on opposing sides of the longitudinal axis.

45. The resonator of Claim 40, further comprising a piezoelectric element located in the opening, the piezoelectric element being sized relative to the opening to stress the sidewalls past their elastic limit.

46. The resonator of Claim 40, further comprising a resilient support element interposed between, and held by compression between, the piezoelectric element and one wall defining the opening.